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EVALUATION OF A NEW TRICKLING FILTER MEDIA.(U)
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EVALUATION OF A NEW TRICKLING FILTER MEDIA

JULY 1977

CEEDO

FINAL REPORT: MARCH 1976-MAY 1976

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CIVIL AND ENVIRONMENTAL
ENGINEERING DEVELOPMENT OFFICE
(AIR FORCE SYSTEMS COMMAND)
TYNDALL AIR FORCE BASE
FLORIDA 32403

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER (14) CEEDO-TR-77-23	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER (9)
4. TITLE (and Subtitle) (6) EVALUATION OF A NEW TRICKLING FILTER MEDIA.		5. TYPE OF REPORT & PERIOD COVERED Final rept. Mar[redacted]–May [redacted]76
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) 1Lt Dale H. Allen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Det 1, CEEDO, HQ ADTC/ECW Air Force Systems Command Tyndall AFB FL 32403		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS (17) 7W 63723F (16) 2103-7W-35
11. CONTROLLING OFFICE NAME AND ADDRESS Det 1, CEEDO, (CNS) Armament Development and Test Center Tyndall AFB FL 32403		12. REPORT DATE (11) Jul[redacted] [redacted]77
		13. NUMBER OF PAGES ~~36~~ (12) 34p.
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release;distribution unlimited

DDC RECEIVED DEC 5 1977 F

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Available in DDC

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Civil Engineering
Environics
Trickling Filter
Filter Media

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An evaluation to determine the effectiveness and loading parameters of a fused silica synthetic media filter known under trade name of Gary Glass was undertaken.

A 15-inch pilot scale trickling filter was set up at the Albuquerque Sewage Treatment Plant using clarified secondary effluent.

A laboratory scale trickling filter was installed using three wastes; synthetic sewage, primary filtered sewage, and Albuquerque sewage.

Results from the pilot scale filter indicate low removal efficiency. → over

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20. Abstract

Laboratory scale filter tests indicate low efficiency using an effluent from another laboratory scale trickling filter. The laboratory scale filter achieved in excess of 90 percent Chemical Oxygen Demand (COD) removal using a sugar and milk solids synthetic sewage. The laboratory scale filter reduced COD of Albuquerque secondary sewage by 60-75 percent. There is no evidence to indicate that this synthetic media achieved better results than any other media for use in trickling filters.

PREFACE

This report was prepared by 1Lt Dale H. Allen for the Civil and Environmental Engineering Development Office. The research was performed under job order 21037W35 between March 1976 and May 1976.

This report has been reviewed by the Information Office (IO) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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SECTION I

INTRODUCTION

A new type media has recently been developed by Gary Aircraft Corporation. This media, trade named Gary Glas,® consists of a porous fused silica in blocks approximately 6 by 3½ by 2½ inches, containing small pore structures. These pores are the basis of a claim that the material possesses a huge surface area to volume ratio, of the order of 10,000 square feet per cubic foot. In addition, it is claimed that the Gary Glas® is an adsorptive media which causes organic material in wastewater to adhere to the media whereby the retention time in the trickling filter is much longer than would ordinarily exist. Adsorptive mechanisms have been found to aid biological decomposition in studies involving the use of activated carbon (References 1 and 2).

Together with the large surface to volume ratio, this adsorptive mechanism is claimed to give this media superior performance with respect to other trickling filter medias. Experiments performed at a San Antonio activated sludge treatment plant indicated that the Gary Glas® reduced the biochemical oxygen demand (BOD) from 30 mg/l to less than 7 mg/l in settled secondary effluent, a 77 percent reduction (Reference 3). Similar tests with settled primary sewage were unsuccessful. Loadings recommended by Gary Aircraft are: 1.25 gallons per minute per square foot, 80 pounds of 5-day biochemical oxygen demand (BOD_5) per 1000 cubic feet per day, and 60 pounds of suspended solids per 1000 cubic feet per day.

A trickling filter is a biological treatment process in which organic materials are degraded by a stationary biological film. The trickling filter itself is usually designed as a shallow circular bed filled with a media on which the micro-organisms grow. Wastewater, which is applied through a rotating distributor, trickles through this media bed into an underdrain system. The underdrain system also serves to aerate the filter, as does the spraying action of the distributor.

If the number of organisms present is large with respect to the amount of organic material, the removal rate will follow first order kinetics (Reference 4):

$$\frac{dc}{dt} = -k\,c$$

or

$$\log C = -kt + C_I$$

where C is the concentration of biodegradable organic matter, k is the rate constant, which, for a particular waste should remain constant, t is the time the organic matter is in contact with the biological organisms, and C_I is the constant of integration. Assuming a constant waste application rate for a trickling filter, time is equivalent to depth. A plot of log C versus depth should yield a straight line if the above assumptions are met.

The organisms growing on the media form a film which, at first, is aerobic. As this film grows, transfer of oxygen to the inner portion of the film is obstructed, causing this portion to become anaerobic. A thick film also inhibits the transfer of organic material into the inner layer because the organics are metabolized by organisms in the outer part of the layer. These inner organisms enter an endogenous growth phase, lose their ability to cling to the media, and are washed from the media, causing the entire film to slough off. This sloughing occurs continuously in trickling filters operated at high hydraulic loadings (References 4 and 5).

The media which supports this biological film in trickling filters usually consists of crushed rock, 1 to 4 inches in diameter. Other material, such as hard coal, coke, cinders, blast furnace slag, wood resistant to rotting, ceramic materials, and plastics have also been used (Reference 5). The media must have a high surface to volume ratio, possess sufficient pore volume so as not to clog easily, and must be durable, strong, and weather resistant.

To assess the performance of the Gary Glas® media, experiments were performed using a pilot scale trickling filter and a laboratory scale trickling filter which was run with three different wastewater sources.

SECTION II

PILOT SCALE TRICKLING FILTER

The pilot scale trickling filter was set up at the Albuquerque Sewage Treatment Plant No. 2, a trickling filter plant. Influent was drawn from a point 1 foot below the surface of one of the plant's secondary clarifiers. Samples were taken over a 24-hour period with a Sigmamotor composite sampler from both the influent line to the pilot scale filter and the clarifier at the bottom of the pilot scale filter (see Figure 1). The 15-inch ID column contained 8 feet of Gary Glas® media. Wastewater was applied through spray nozzles supported by a plexiglas top, with forced aeration produced by a kitchen exhaust fan mounted on the top. Loadings on the filter were governed by the COD-BOD loads. The volumetric flow rate used was 1.7 l/min (0.45 gal/min). This produced a hydraulic loading of 0.37 gal/min-sq ft, well below that recommended by the manufacturer. The COD loading was 86.4 lb COD per 1000 cu ft per day. Assuming 1 lb COD is equivalent to 0.6 lb BOD_5, this is equivalent to 51.18 lb BOD_5/1000 cu ft per day (Reference 6). Suspended solids averaged 50 mg/l, a loading of 27.4 lb/day-1000 cu ft.

Composite sampling was begun 24 days after the filter was placed in operation. COD analyses were conducted on these samples (Table 1) and portions of these samples which had been filtered through glass fiber (GF/C) filter paper to remove the COD associated with suspended solids. These data are presented in Figures 2 and 3. Overall COD removal was 22.5 percent for the unfiltered samples (ignoring day 6) and 29.4 percent for the filtered samples. All effluent samples had a dissolved oxygen concentration of at least 2 mg/l, indicating that sufficient aeration existed in the filter.

After the filter was shut down, individual pieces of media were examined. A thick (1-3 mm) biological film had formed on the exterior of all of the media. In places this film had sloughed off (see Figures 4, 5, and 6), becoming accumulated in the void space between various pieces of media. The interior of the media had little, if any discoloration, indicating that this surface area was not available for biological activity. Those areas which had become discolored near the surface showed no evidence of biological slime. New water was poured on the top surface. Media surrounded by this film would not pass water through it; rather, the water flowed around and down the sides. This does not mean that no organic material reached the interior pore space; however, it does strongly suggest that little degradation occurred there.

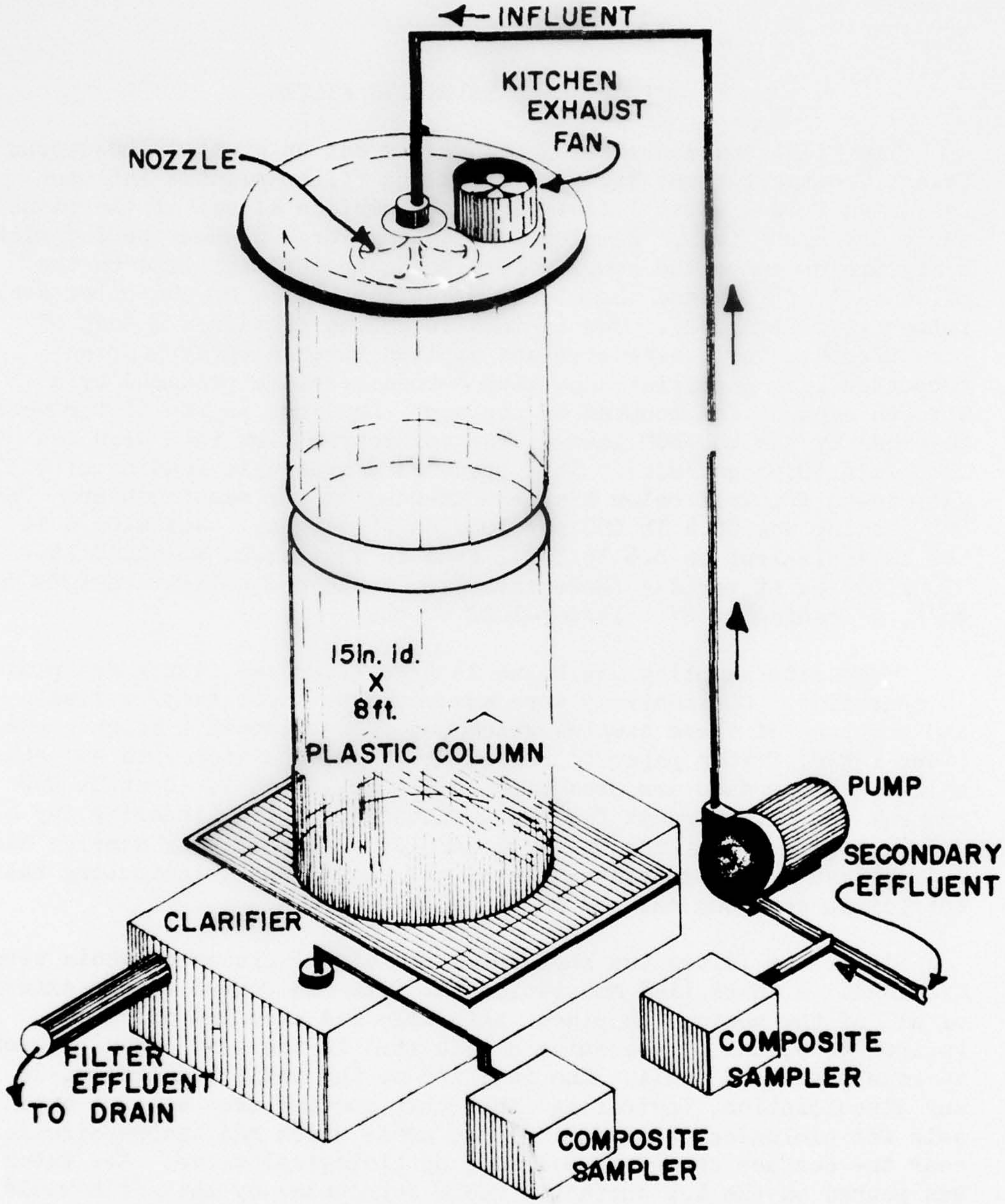

Figure 1. Scale Trickling Filter Schematic

TABLE 1. COD PILOT SCALE TRICKLING FILTER USING ALBUQUERQUE EFFLUENT (COMPOSITE SAMPLES)

Day	Influent	Effluent	Percent Reduction
1	94.8	67.7	28.6
3	76.1	43.7	42.6
4	44.5	37.2	16.4
6	58.5	46.3	20.9
7	56.7	42.1	25.7
8	51.8	38.9	24.9
9	53.4	34.0	36.3
10	94.1	109.2	-16.0
14	54.3	39.7	26.9
15	60.7	54.3	10.5
16	165.0	37.4	77.3
19	46.2	54.3	-17.5
AVERAGE	71.34	50.40	29.4

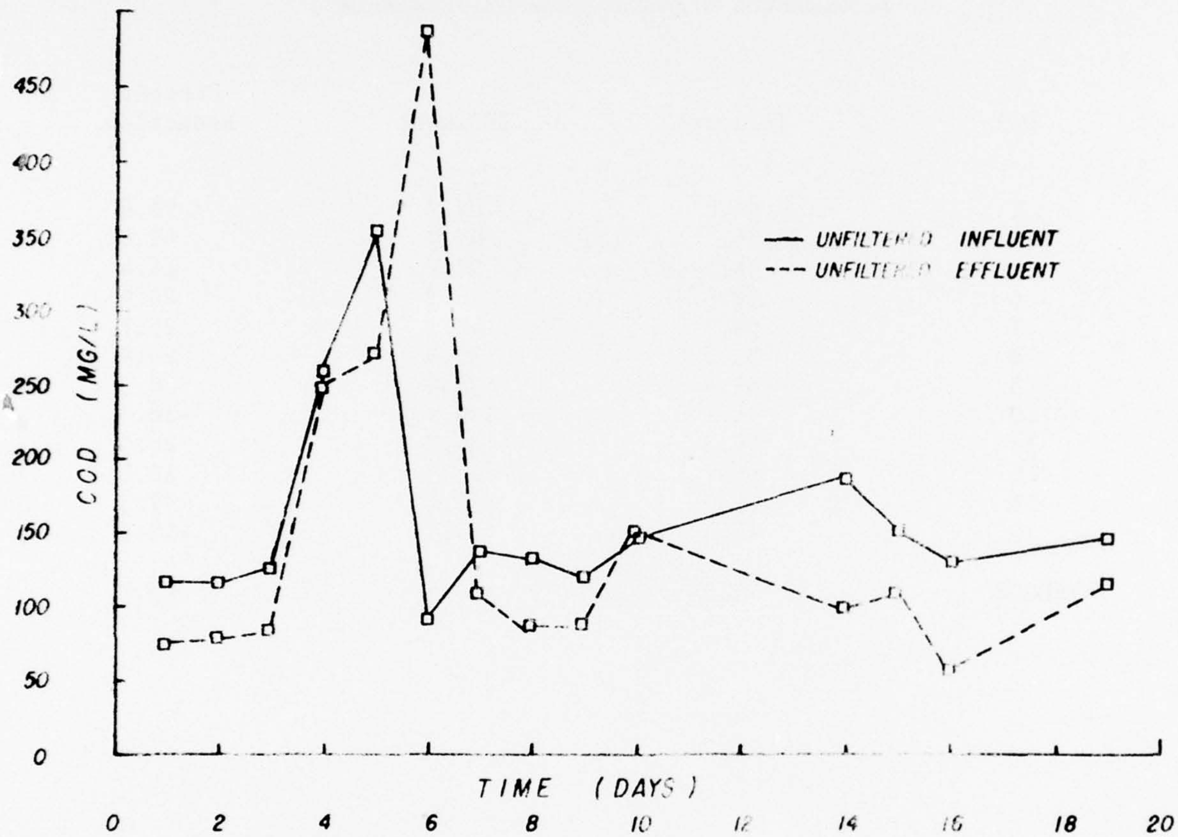

Figure 2. Unfiltered COD Versus Time for Pilot Scale Filter at Albuquerque Plant

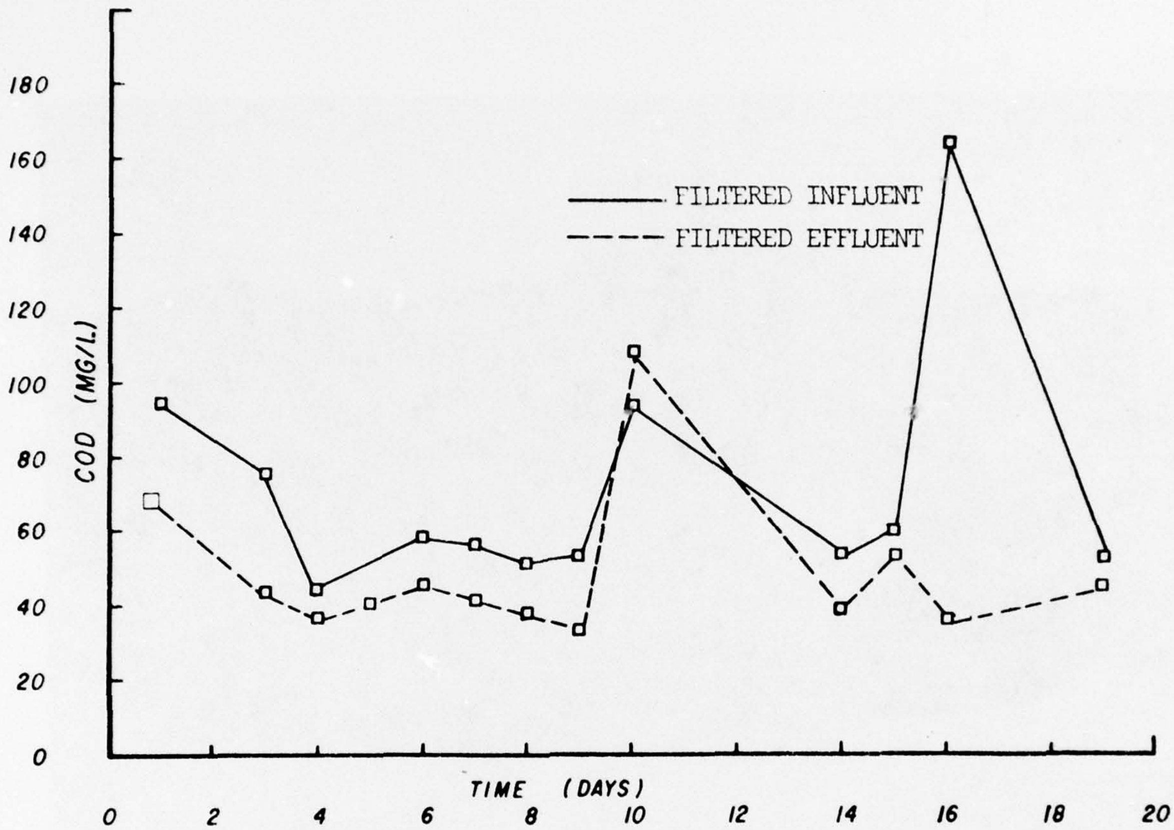

Figure 3. Filtered COD Versus Time for Pilot Scale Filter at Albuquerque Plant

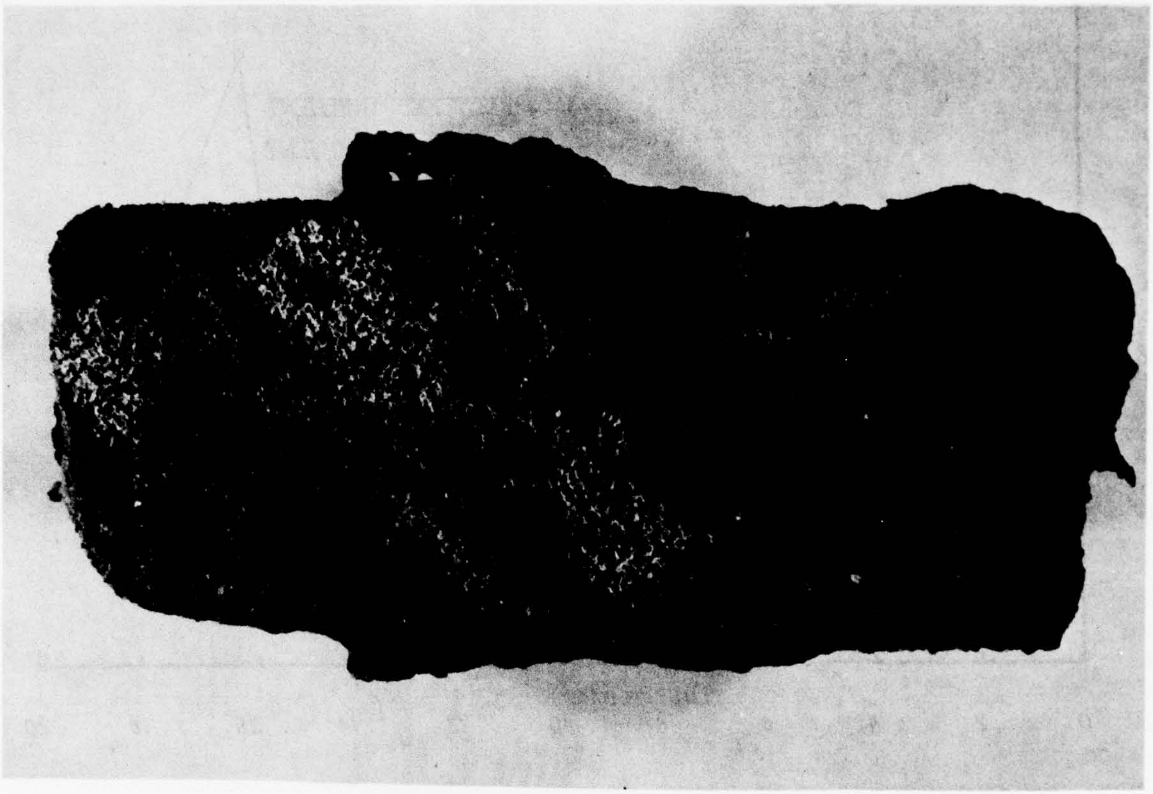

Figure 4. Exterior of Media from Pilot Scale Trickling Filter

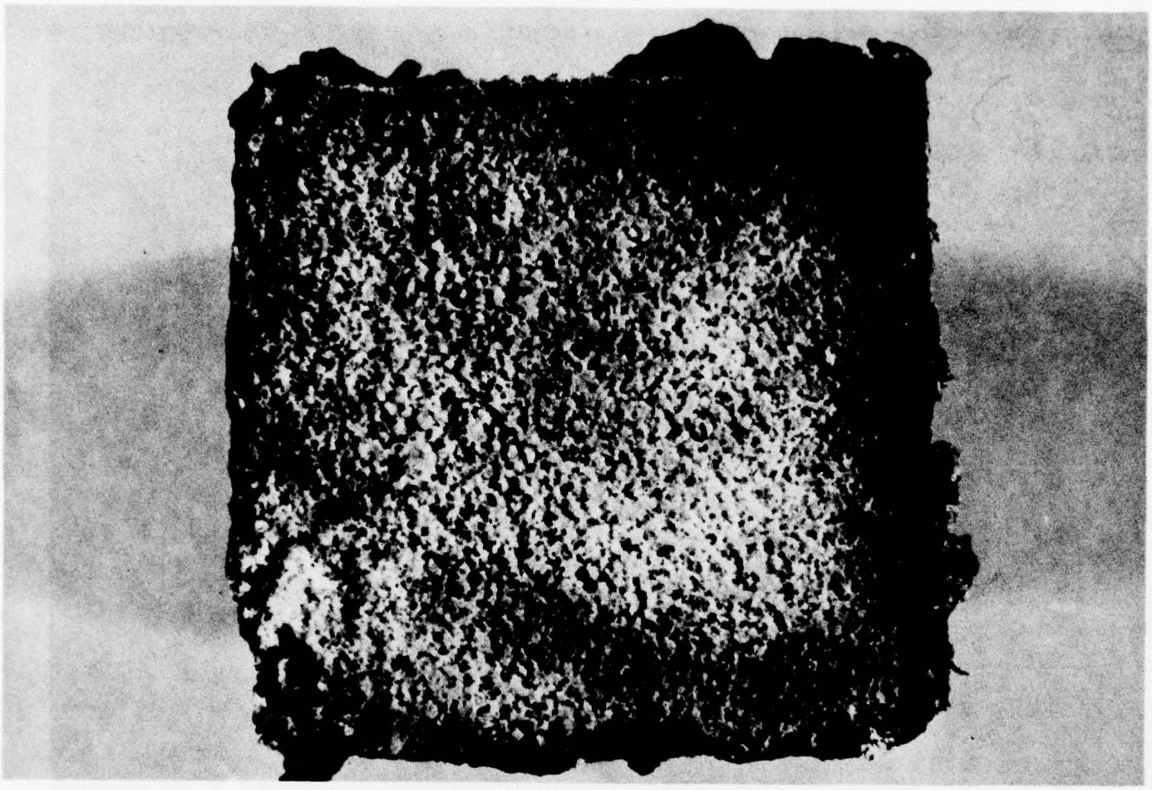

Figure 5. Cross Section of Media from Pilot Scale Trickling Filter

Figure 6. Cross Section of Media from Pilot Scale Trickling Filter

SECTION III

LABORATORY SCALE TRICKLING FILTER

An evaluation was performed using a laboratory scale trickling filter. The synthetic media was cut up into small 2 by 1½ by 1 inch blocks. In order to accommodate large hydraulic loadings, a small 3-inch ID column was utilized. Influent wastewater was introduced into the top of the column through two small nozzles as shown in Figure 7. Influent wastewater was stored in two 40-gallon tanks. To minimize biological activity in the influent tanks, they were cleaned with a 5 percent chlorine solution weekly, and new wastewater mixed or procured on a 48-hour basis. Aeration was provided by passing compressed air through a diffusion stone in the column top (Sample ports were placed at approximately 1/3 and 2/3 depth points), with the column bottom resting on a wire grid. This grid rested on a plastic container which served as a clarifier. A sequence of experiments was run using three influent sources with the same media.

SYNTHETIC SEWAGE RUN

The influent source was sewage diluted to approximately 120 mg/l COD. A hydraulic loading of 0.54 gal/min-sq ft was maintained, with a COD loading of 30 lb/day-1000 cu ft. COD data are presented in Figure 8. Average COD reduction was 92 percent (See Table 2). During this period a rich, black biological film developed on the media. Effluent samples were practically free of turbidity. The kinetic data presented in Figure 9 were computed by averaging the COD data from all four sampling points. This indicates first order kinetics as previously discussed.

PRIMARY FILTER EFFLUENT RUN

Because the first run using the effluent from the laboratory scale primary filters was accomplished under startup conditions when little biological growth was present, another run using this influent source was begun. These data are presented in Figure 10. Average overall COD reduction was 63.6 percent (See Table 3). The average efficiency of the first set of trickling filters was 90.39 percent (note that it is very close to the average efficiency of the Gary Glas® filter using the same synthetic sewage formulation). The second stage efficiency calculated from the NRC formula is predicted to be 34.5 percent (Reference 4). This formula which was developed by the National Research Council from an extensive study of trickling filters serving military installations predicts filter efficiency as a function of organic loading, filter cross-sectional area, and recirculation. The measured average efficiency during this run

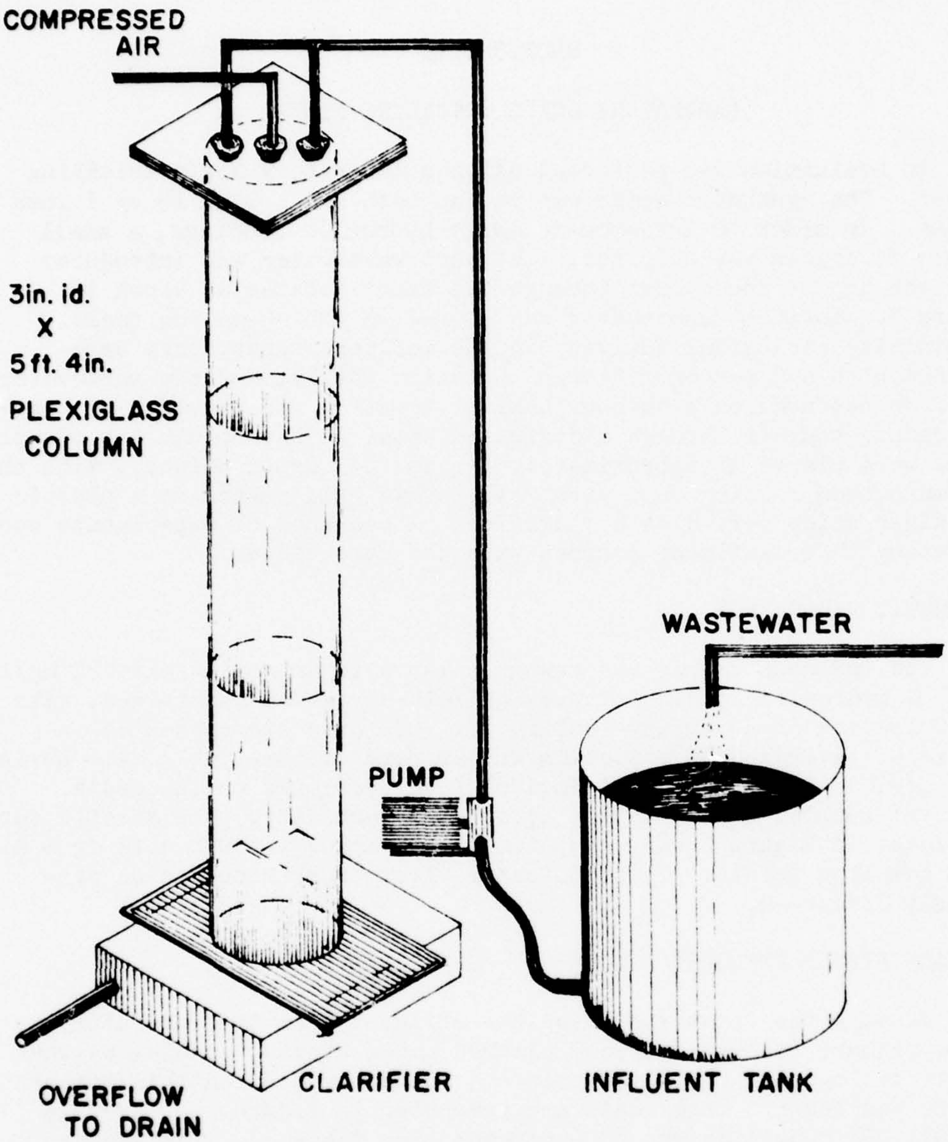

Figure 7. Laboratory Scale Trickling Filter

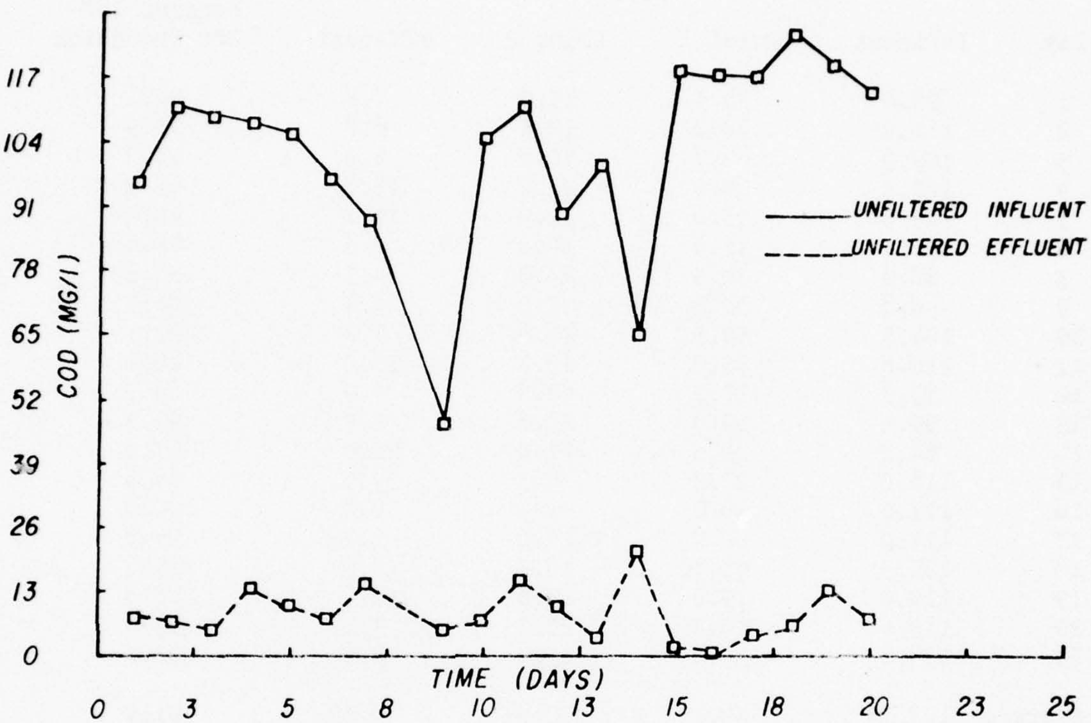

Figure 8. COD Versus Time for Laboratory Scale Trickling Filter Using Synthetic Sewage

TABLE 2. COD LABORATORY SCALE FILTER USING SYNTHETIC SEWAGE

Day	Influent	Point 1	Point 2	Effluent	Percent Inf-Eff Reduction
1	95.8	35.6	11.9	7.6	92.1
2	111.0	50.8	10.2	6.8	93.9
3	109.0	62.7	50.8	5.1	95.3
4	107.7	69.2	21.4	13.7	87.3
5	105.5	55.0	11.9	10.1	90.4
6	96.4	13.6	19.1	7.3	92.4
7	88.2	34.5	27.0	14.5	83.6
9	46.8	30.6	9.0	5.4	88.5
10	104.5	59.5	21.6	7.2	93.1
11	110.8	73.0	23.4	15.3	86.2
12	89.3	17.5	42.8	9.9	88.9
13	99.1	59.8	27.8	3.7	96.3
14	64.8	29.5	21.9	21.0	67.6
15	118.0	32.0	8.3	1.8	98.5
16	117.0	56.0	----	0.0	100.0
17	117.0	60.0	16.0	3.7	96.8
18	125.5	65.7	13.7	5.9	95.3
19	119.0	79.0	23.8	13.3	88.8
20	113.6	66.2	20.2	7.1	93.8
21	123.8	32.4	15.2	8.5	93.1
Average	103.14	49.13	20.84	8.39	91.9

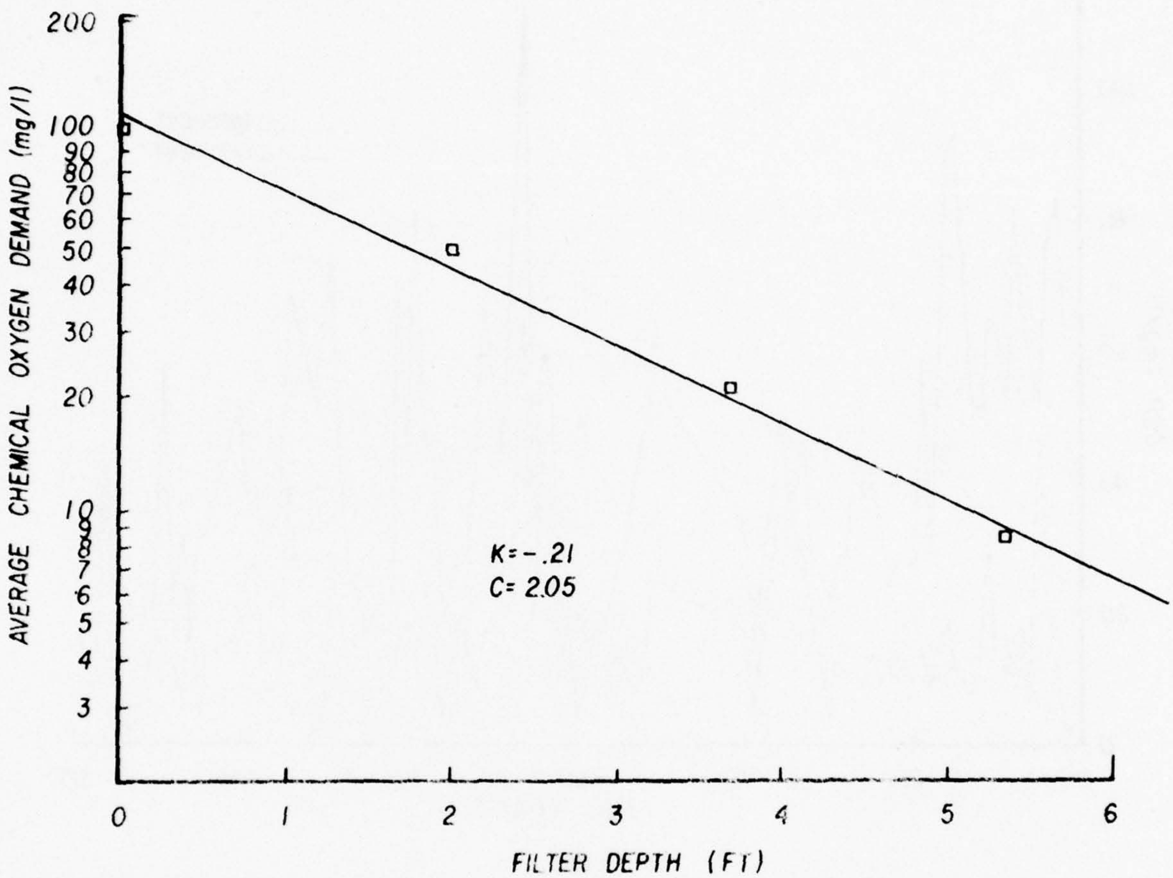

Figure 9. Log Plot COD Average Versus Depth for Lab Scale Trickling Filter Using Synthetic Sewage

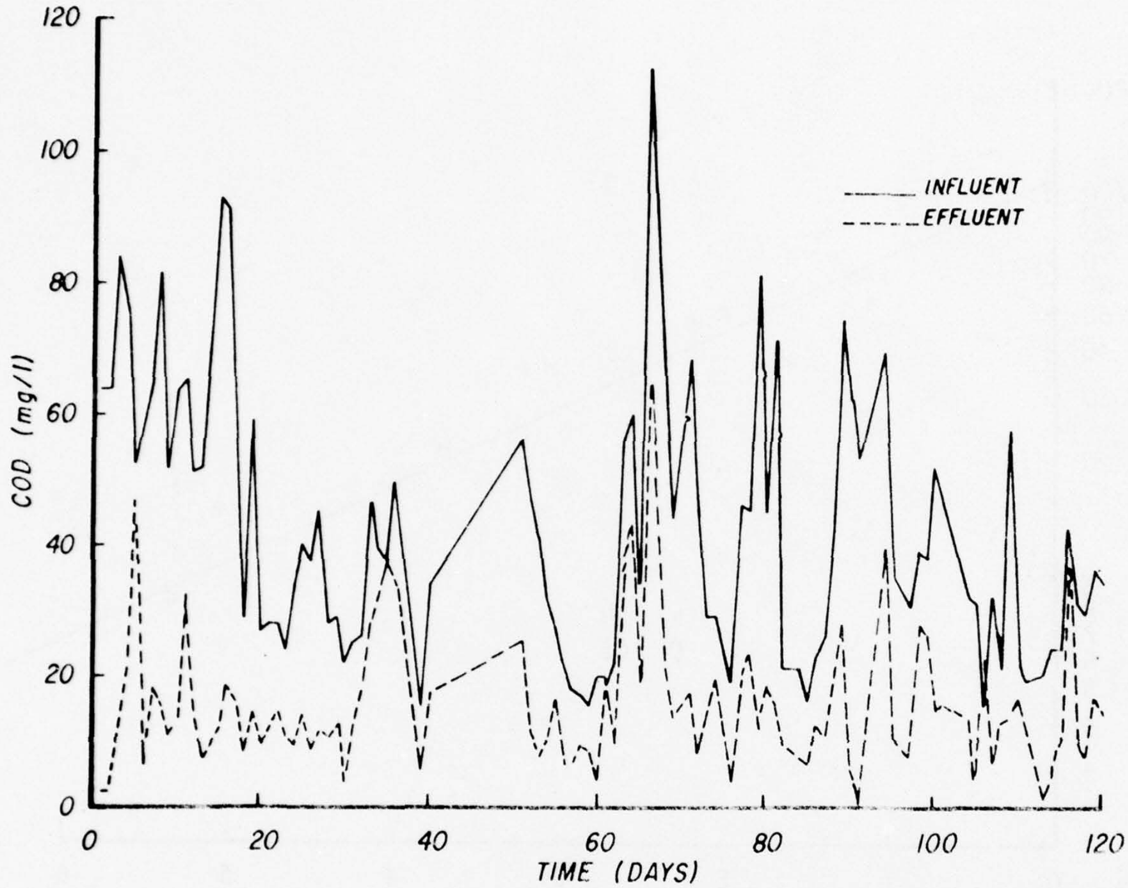

Figure 10. COD Versus Time for Laboratory Scale Trickling Filter Using Secondary Effluent

TABLE 3. COD LABORATORY SCALE TRICKLING FILTER USING EFFLUENT FROM LABORATORY SCALE PRIMARY TRICKLING FILTER

Day	Influent	Point 1	Point 2	Effluent	Percent Inf-Eff Reduction
1	63.8	49.5	12.4	1.9	97.2
2	63.8	49.5	12.4	1.9	97.2
3	83.8	60.0	20.0	12.4	85.2
4	75.5	58.5	25.5	20.8	72.5
5	52.3	85.4	35.2	46.2	11.7
6	58.3	53.3	60.3	6.0	89.7
7	64.4	30.7	20.8	17.8	72.4
8	81.2	6.9	----	14.9	81.7
9	52.0	26.5	11.8	10.8	79.2
10	63.7	15.7	1.0	12.7	80.1
11	65.2	86.2	36.5	32.2	50.6
12	51.1	35.5	9.5	13.9	72.8
13	51.9	15.1	16.7	6.7	87.1
15	93.0	47.0	36.0	12.0	87.1
16	91.0	22.0	----	18.0	80.2
17	59.0	41.0	27.0	15.0	74.6
18	29.0	20.0	12.0	8.0	72.4
19	59.0	4.0	6.0	14.0	76.3
20	27.0	21.0	5.0	9.0	66.7
21	28.0	31.0	22.0	12.0	57.1
22	28.0	31.0	14.0	16.0	42.9
23	24.0	18.0	----	10.0	58.3
24	34.0	12.0	12.0	9.0	73.5
25	40.0	14.0	17.0	14.0	65.0
26	37.0	18.0	11.0	8.0	78.4
27	45.0	40.0	11.0	11.0	75.6
28	28.0	--	27.0	10.0	64.3
29	29.0	--	16.0	12.0	58.6
30	22.0	11.0	7.0	3.0	86.4
Average	51.72	33.44	18.66	13.07	74.73
31	25.0	16.0	23.0	12.0	52.0
32	26.0	21.0	14.0	17.0	34.6
33	47.0	--	33.0	28.0	40.4
34	39.0	--	36.0	33.0	15.4
35	37.0	--	39.0	37.0	0.0
36	49.0	--	37.0	33.0	32.7
39	15.0	--	4.0	5.0	66.7
40	34.0	37.0	26.0	17.0	50.0
51	56.0	64.3	31.0	25.0	55.4

TABLE 3. COD LABORATORY SCALE TRICKLING FILTER USING EFFLUENT FROM LABORATORY SCALE PRIMARY TRICKLING FILTER (continued)

Day	Influent	Point 1	Point 2	Effluent	Percent Inf-Eff Reduction
52	47.0	28.0	13.0	11.0	76.6
53	41.0	21.0	20.0	7.0	82.9
54	32.0	7.0	14.0	10.0	68.8
55	28.0	19.0	18.0	16.0	42.9
56	22.0	--	2.0	6.0	72.7
57	18.0	11.0	12.0	6.0	66.7
58	17.0	12.0	18.0	9.0	47.1
59	16.0	14.0	12.0	8.0	50.0
60	20.0	3.0	6.0	3.0	85.0
61	18.0	21.0	17.0	19.0	-5.6
62	22.0	13.0	10.0	9.0	59.1
63	56.0	68.0	44.0	36.0	35.7
64	60.0	50.0	48.0	43.0	28.3
65	34.0	23.0	34.0	18.0	47.1
66	112.0	77.0	88.0	64.0	42.9
67	79.0	62.0	42.0	40.0	49.4
68	59.0	39.0	52.0	22.0	62.7
69	44.0	31.0	--	13.0	70.5
71	68.0	43.0	26.0	17.0	75.0
72	44.0	20.0	24.0	8.0	81.8
73	29.0	22.0	19.0	--	
74	29.0	22.0	19.0	19.0	34.5
Average	39.45	28.82	26.03	19.7	50.07
76	19.0	13.0	10.0	3.0	84.2
77	46.0	30.0	32.0	19.0	58.7
78	45.0	49.0	12.0	23.0	48.9
79	81.0	11.0	8.0	11.0	86.4
80	45.0	43.0	22.0	18.0	60.0
81	71.0	--	--	15.0	78.9
82	21.0	15.0	10.0	9.0	57.1
84	21.0	10.0	11.0	7.0	66.7
85	16.0	11.0	8.0	6.0	62.5
86	23.0	19.0	16.0	12.0	47.8
87	26.0	26.0	18.0	10.0	61.5
88	41.0	34.0	18.0	18.0	56.1
89	74.0	--	53.0	27.0	63.5
90	62.0	14.0	--	5.0	91.9
91	53.0	32.0	22.0	0.0	100.0

TABLE 3. COD LABORATORY SCALE TRICKLING FILTER USING EFFLUENT FROM LABORATORY SCALE PRIMARY TRICKLING FILTER (concluded)

Day	Influent	Point 1	Point 2	Effluent	Percent Inf-Eff Reduction
94	69.0	33.0	42.0	39.0	76.9
95	35.0	13.0	20.0	10.0	71.4
97	30.0	13.0	9.0	7.0	76.7
98	39.0	45.0	40.0	27.0	30.8
99	38.0	34.0	32.0	26.0	31.6
100	52.0	48.0	42.0	14.0	73.1
101	46.0	14.0	15.0	15.0	67.4
104	32.0	24.0	23.0	13.0	59.4
105	31.0	32.0	28.0	4.0	87.1
106	16.0	21.0	23.0	22.0	-27.3
107	32.0	14.0	10.0	6.0	81.3
108	21.0	17.0	16.0	12.0	42.9
109	57.0	16.0	15.0	13.0	77.2
110	21.0	18.0	13.0	16.0	23.8
111	19.0	13.0	14.0	14.0	26.3
113	20.0	17.0	5.0	1.0	95.0
Average	38.77	23.41	20.24	13.61	64.89
114	24.0	15.0	6.0	4.0	83.3
115	24.0	4.0	4.0	11.0	54.2
116	42.0	50.0	46.0	39.0	7.1
117	31.0	28.0	6.0	10.0	67.7
118	29.0	--	--	7.0	75.9
119	36.0	20.0	8.0	16.0	55.6
120	34.0	21.0	--	14.0	58.8
Average	31.49	23.00	14.00	14.49	53.99
Average	42.30	28.06	21.37	15.40	63.59

nearly doubles this predicted efficiency. A removal of 29.9 percent of the nitrite ammonia and organic nitrogen occurred during a period of this run. However, an increase of 38.4 percent total nitrogen occurred. Because the only significant nitrogen source was the biological film which grew on the easily degraded synthetic sewage, it appeared that this film itself was being degraded.

Kinetic data for this run are presented in Figure 11. The composite data are indicative of first order kinetics, however, data for the individual time segments are very erratic, perhaps indicating short circuiting within the filter as individual pieces of media became clogged or that the organisms in different sections of the filter varied as to the particular growth phase they were in.

ALBUQUERQUE EFFLUENT RUN

An extended run was also made using Albuquerque effluent. This effluent was filtered through a mixed media filter which reduced the suspended solids (non-filterable residue) from the range of 60-40 mg/l to 20 mg/l (Reference 7). Data from this run are presented in Figure 12 and Figure 13. Average COD reduction was 57 percent, which declined somewhat as the run progressed (see Table 4).

The kinetic data for this run indicate a faster rate of degradation in the upper third of the filter, with the lower and middle sections being the same. The overall rate is slightly lower than that of the run with the effluent from the laboratory scale primary trickling filter and approximately 1/3 that of the run with the synthetic sewage.

A removal of 37.9 percent of the nitrite, ammonia, and organic nitrogen occurred during a 5-day period late in the run. A total nitrogen removal of 59.4 percent was observed. (See Table 5).

On dismantling the filter, the media was again examined. The interiors of the pieces were almost uniformly discolored, with a slimy coating extending 1-5 mm inside from the surface of the media. Again, when water was poured onto the surface of this media, it flowed around the exterior instead of penetrating through the interior of the media.

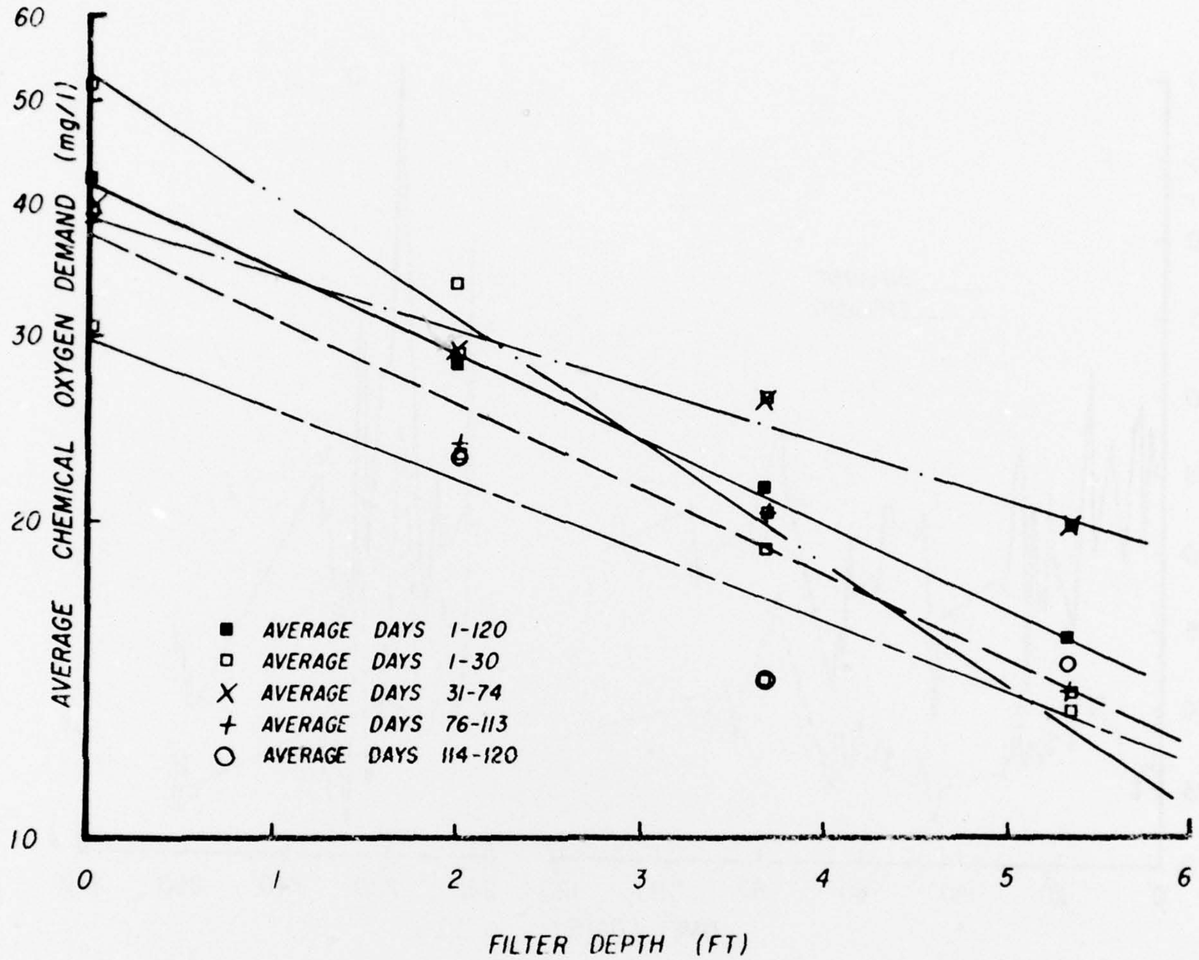

Figure 11. COD Average Versus Depth for Lab Scale Trickling Filter Using Effluent from Lab Scale Primary Trickling Filter

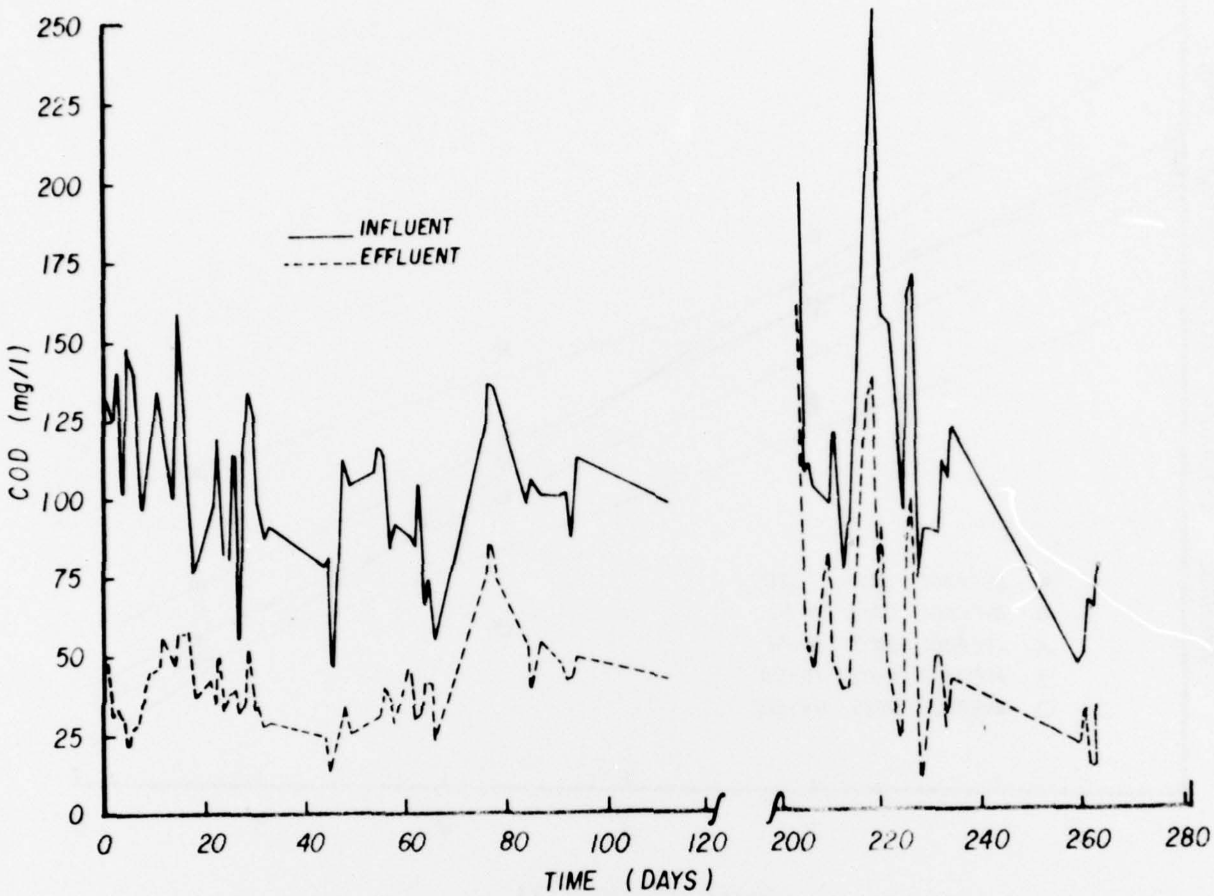

Figure 12. COD Versus Time for Laboratory Scale Filter
Albuquerque Effluent

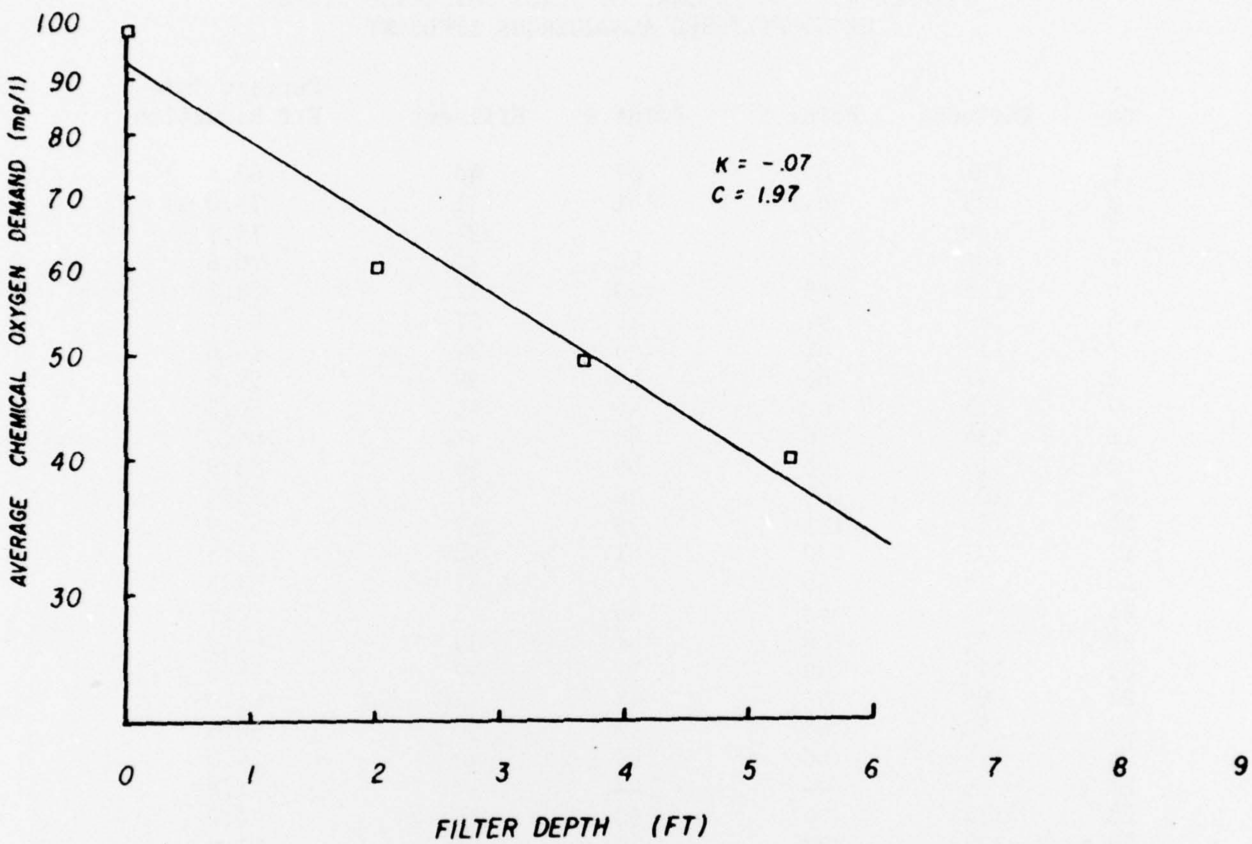

Figure 13. Log Plot COD Average Versus Depth Lab Scale Trickling Filter Using Filtered Albuquerque Effluent

TABLE 4. COD LABORATORY SCALE TRICKLING FILTER
USING FILTERED ALBUQUERQUE EFFLUENT

Day	Influent	Point 1	Point 2	Effluent	Percent Inf-Eff Reduction
1	131	83	67	48	63.4
2	125	61	41	31	75.2
3	140	57	34	34	75.7
4	102	42	46	30	70.6
5	148	45	29	22	85.1
6	140	91	30	27	80.7
7	115	62	44	29	74.8
8	97	65	49	39	59.8
9	111	82	49	45	59.5
11	134	76	60	47	64.9
12	119	68	65	56	52.9
14	100	67	72	47	53.0
15	158	123	95	57	63.9
17	91	70	81	58	36.3
18	76	58	74	37	51.3
21	91	63	46	43	52.7
22	97	66	41	35	63.9
23	119	80	31	49	58.8
24	82	53	44	32	61.0
25	80	64	53	38	52.5
26	114	66	45	40	64.9
27	55	--	--	32	41.8
28	114	79	60	34	70.2
29	134	77	59	51	61.9
30	126	57	36	33	73.8
31	98	48	38	34	65.3
32	87	53	32	28	67.8
33	91	41	35	29	68.1
44	78	29	31	24	69.2
45	81	23	31	13	84.0
46	48	29	29	18	62.5
48	112	33	40	34	69.6
49	104	41	36	25	76.0
54	108	42	32	30	72.2
56	114	43	37	40	64.9
57	84	41	36	36	57.1
58	92	37	--	29	68.5
61	88	45	39	46	47.7
62	84	46	44	30	64.3
63	104	58	51	32	69.2

TABLE 4. COD LABORATORY SCALE TRICKLING FILTER
USING FILTERED ALBUQUERQUE EFFLUENT
(continued)

Day	Influent	Point 1	Point 2	Effluent	Percent Inf-Eff Reduction
64	66	46	48	41	37.9
65	74	43	44	41	44.6
66	55	37	31	23	58.2
76	121	78	71	75	38.0
77	135	102	94	85	37.0
78	134	99	91	75	44.0
84	97	57	54	54	44.3
85	106	48	47	39	63.2
87	101	--	60	54	46.5
91	100	56	56	47	53.0
92	101	51	47	42	58.4
93	87	47	27	43	50.6
94	112	64	61	49	56.3
112	97	--	70	42	56.7
Average	99.47	59.98	49.08	39.69	60.0
203	198	110	126	159	19.7
203	107	99	96	93	13.1
205	109	66	80	51	53.2
206	102	60	80	44	56.9
209	97	82	102	80	17.5
210	119	95	66	45	62.2
212	75	67	60	37	50.7
213	90	60	45	37	58.9
217	211	116	137	129	38.9
218	252	109	102	136	46.0
219	170	95	--	68	60.0
220	156	88	73	89	42.9
221	154	117	88	44	71.4
224	95	73	59	22	76.8
225	161	129	121	81	49.7
226	169	129	121	97	42.6
227	72	64	40	32	55.6
228	88	76	52	8	90.9
231	87	102	55	47	46.0
232	110	94	39	47	57.3
233	104	72	72	24	76.9
234	120	72	64	40	66.7

TABLE 4. COD LABORATORY SCALE TRICKLING FILTER
USING FILTERED ALBUQUERQUE EFFLUENT
(concluded)

Day	Influent	Point 1	Point 2	Effluent	Percent Inf-Eff Reduction
259	45			20	55.6
260	49			20	59.2
261	65			29	55.4
262	63			12	81.0
263	76			29	61.8
Average	116.44	89.77	76.27	56.29	51.66
Average 1-263	105.06			45.16	57.02

TABLE 5. NITROGEN DATA FOR LABORATORY SCALE FILTER

Parameter (mg/l as N)	Averages Day 111-115 Laboratory Scale Primary Filter Effluent Run		Averages Day 85-96 Filtered Albuquerque Effluent Run	
	Influent	Effluent	Influent	Effluent
NO_3^-	0.024	17.82	0.0	4.37
NO_2^-	0.00846	1.30	0.0	0.97
NH_3	17.93	11.77	18.1	5.96
ORGANIC N	1.32	0.43	2.23	1.33
N_T	19.28	31.32	20.33	12.63

SECTION IV

CONCLUSIONS

When installed in a pilot scale filter, the media failed to yield adequate performance, perhaps due to the accumulation of suspended solids and biological film within the media. Examination of the media indicated that little if any of the large surface area of the interior of the media had been biologically active.

A comparison with the results obtained from the same wastewater, but filtered to reduce the suspended solids and with the media cut into much smaller pieces shows enhanced performance. It is apparent that this media is sensitive to both of these parameters.

It is also apparent that the large surface area of this media is largely unused. Slime layers growing on the exterior of the media apparently block the transfer of organic material and oxygen to the interior. The adsorptive nature of the media may be an aid to its performance. The laboratory scale trickling filter did achieve better than predicted reduction of the COD of the effluent from the laboratory scale trickling filter. Furthermore, when used on synthetic sewage, the COD reduction was comparable to that of the primary filter operating at 1/8 the hydraulic loading and 1/2 the organic loading.

In summary, there is no evidence to indicate that this synthetic media achieved significantly better results than other media currently in use in trickling filters.

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